

ON THE IMMATURE STAGES OF *PSALYDOLYTTA FUSCA*  
(COLEOPTERA: MELOIDAE)

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*Abstract.*—Egg masses laid by 27 females of *Psalydolytta fusca* (Olivier) from The Gambia contained a mean of 125.2 eggs. Mean incubation time at 27°C was 22.3 days in 19 masses that produced larvae. Within individual egg masses the hatching period extended over a period of 2–9 days (mean 5.1). Anatomical characteristics of the triungulin (first instar) larva, described in detail, confirm that *Psalydolytta* is an epicautine. The larva is the largest known in Meloidae and has unusually abundant setae on the dorsum of the head and body. Triungulin larvae of *P. fusca* and first grub larvae presumed to represent this species were found in egg pods of the grasshopper *Cataloipus fuscoeruleipes* (Sjöstedt) at Tumani Tenda, Western Division, The Gambia. This is the first record of a meloid preying on an acridid of the subfamily Epyreopnemiinae.

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The genus *Psalydolytta* Péringuey is represented in Africa by 42 species and in India by an additional 10 (Kaszab, 1954; Saha, 1979; Selander, 1986). In both regions adults feed primarily or exclusively on grasses, including wild species of *Andropogon* and *Cymbopogon* as well as cultivated species of *Eleusine*, *Oryza*, *Panicum*, *Pennisetum*, *Setaria*, *Sorghum*, and *Zea*. Feeding, which generally occurs at night, destroys flowers and developing grains. When adults are numerous they may seriously reduce crop yields or, at worst, destroy an entire harvest. In addition, adults attracted to lights at night in public places are sometimes a nuisance because, when crushed against the skin, they cause blistering and other irritation (Giglioli, 1965; Zethner et al., 1985; and other references in Selander, 1986).

In the taxonomic literature of the Meloidae *Psalydolytta* has been associated consistently with the genus *Epicauta* Dejean,

which is assigned, together with its close relatives, to a separate tribe or subtribe of Meloinae (e.g., Kaszab, 1954, 1959, 1969; Selander, 1955; MacSwain, 1956; Saha, 1979). Indeed, there is little to distinguish *Psalydolytta* as a genus apart from *Epicauta* except the peculiar conformation of the mandibles of the adult, and even this is paralleled to a certain extent in some Nearctic and Ethiopian species that undoubtedly belong in *Epicauta*. The mandibles in *Psalydolytta* are enlarged, strongly bent backward (vaulted), and do not overlap distally as they do in most Meloidae. It has been conjectured that these modifications are in some way adaptive in feeding on the inflorescences of wild grasses (Selander, 1986). Additional evidence for associating *Psalydolytta* with *Epicauta* is found in Fletcher's (1914) report that young larvae of the Indian *P. rouxi* (Castelnau) fed freely on the eggs of the pyrgomorphid *Colemania*

*sphenarioides* Bolívar in the laboratory and that a pupa was found associated with the eggs of this grasshopper in nature. Fletcher did not describe the larva of *P. rouxi*, and there are no other references to the immatures of *Psalydolytta* in the literature.

Recently, interest in the biology of *Psalydolytta* has been stimulated by economic losses resulting from attacks on pearl millet (*Pennisetum americanum*) in West Africa by several species, the most important of which are *P. vestita* (Dufour), in Mauritania and Mali, and *P. fusca* (Olivier), in southern Senegal, The Gambia, and northeastern Guiné-Bissao. Partial results of a three-year study of the bionomics, economic impact, and control of *P. fusca* in The Gambia are given in the present paper. Specifically, the egg stage is treated briefly, the triungulin (first instar) larva is described in detail, and evidence concerning the mode of larval development is reported. The principal results of the study will be published elsewhere (Zethner and Laurence, 1987).

#### EGG STAGE

Between 18 September and 20 October 1985, 50 gravid females of *Psalydolytta fusca* collected in pearl millet fields, at a light trap in Yundum, and at lights at the Yundum airport were confined individually in cotton-stoppered glass vials 10 cm in height and 2.5 cm in internal diameter. Each vial contained a strip of paper that, by limiting the movement of the female, prevented eggs from being trampled after they had been laid. No food was provided. This procedure was adopted after trials in which adults were maintained in groups of 2-11 in plastic cages with earheads of pearl millet as food resulted in short survival (median 10 days) and little oviposition. (In retrospect it appears that the poor results were caused by overcrowding.)

Over a period of 1-5 days of confinement (mean = 2.0 days), 27 of the females oviposited, producing from 36 to 225 eggs each

(mean = 125.2, SE = 9.08). Comparable figures for *P. rouxi* reported by Fletcher (1914) were 50 and 125, respectively. The egg masses of both species are numerically smaller than average for Meloidae but well within the normal range for species of *Epicauta*, which characteristically produce relatively large eggs in masses of at most a few hundred (Adams and Selander, 1979; Selander, 1981). Individually, the eggs of *P. fusca* are cream colored, weakly tapered, about 3.5 mm in length, and roughly 1/3 as wide as long.

Shortly after deposition, eggs were removed from the glass vials and, using a fine brush, transferred in groups of five to plastic vials 7 cm in height and 1 cm in internal diameter in which they were incubated in darkness at 100% R.H. and 30°C. Hatching was recorded in 15 of the egg masses from individually confined females and in four additional masses from females kept in plastic cages with food material. Among these 19 masses the percentage of hatching ranged from 0.5 to 89.9, with a mean of only 33.8 (SE = 6.48). The low mean value is attributable, we believe, partly to failure of females, under starvation, to fertilize eggs properly and partly to damage to eggs as a result of handling. Except for four cases in which only one or two eggs hatched, hatching of the eggs in a mass occurred over a period of 2-9 days (mean = 5.1, SD (pooled estimate) = 1.42, n = 15). Mean days to hatching in the 19 masses ranged from 20.1 to 25.0 days, with an unweighted mean of means of 22.3 days (SE = 0.31). According to Fletcher (1914), eggs of *P. rouxi*, at unspecified temperature, hatched in about 15 days.

#### DESCRIPTION OF TRIUNGULIN LARVA

Figs. 1-3, 4b

Anterior, median and posterior rows of setae on a sclerite are denoted AR, MR, and PR, respectively. Within a row, a seta is referenced by its ordinal position from the

midline of the body. Lengths of segments of the antenna and maxillary and labial palpi were measured on the ventral midline.

Color medium brown; pronotum dark brown in posterior  $\frac{2}{3}$  and along lateral margins in anterior  $\frac{1}{3}$ . Sclerotized cuticle with weak, transverse reticulations, becoming obsolete medianly on dorsum and venter of head and medianly on pronotum; weak tendency for reticulations on abdominal pleurites and posterior abdominal tergites to be drawn into short spines; membranous cuticle, except that of clypeus, smooth. Setae in general long, conspicuous; those on dorsum of head, thorax, and abdomen unusually numerous, for most part bifid (very rarely trifid) at apex; ventral setae normal in number, very rarely divided at apex.

Head (excluding labrum) as long as pro- and mesothorax combined, barely wider than long, widest across stemmata; sides constricted, sinuate behind middle, reducing basal width to  $\frac{7}{10}$  maximum width. Stem of epicranial suture about  $\frac{3}{5}$  as long as head; lateral arms attaining antennal foramina. Stemma unusually large and prominent, perfectly spherical; diameter greater than  $1\frac{1}{2}\times$  width of antennal segment II, greater than width of maxillary palpal segment II. Epicranium with 114–118 setae (12–14 on front, 10–14 lateral, 10 ventral); dorsal setae posteriad of level of stemmata clustered as in Fig. 1, not arranged in recognizable rows; major ocular seta inserted just mesad of stemma, not bifid, longer than antenna, at least  $2\times$  as long as most setae outside ocular area; seta directly posteriad of stemma longer than most other setae, inserted very near stemma; four minor setae on each side of epicranium at base, arranged longitudinally in nearly straight line; sensory cone mesad of posteriormost minor seta and another just anterior of major ocular seta. Four or (as shown in Fig. 1) five setae on each side of frontal area, their insertions inset from branch of epicranial suture but roughly paralleling it; setae subequal in length. Row of

4 setae on anterior margin of front;  $AR_2$  much longer than other frontal setae; sensory cone and pit between  $AR_1$  and  $AR_2$ . Clypeus semimembranous, microstriate. Labrum with anterior  $\frac{1}{2}$  of dorsal surface membranous in median  $\frac{1}{2}$ ; anterior margin rounded, very long seta ( $\frac{1}{2}$  as long as mandible) on anterior corner, shorter one submarginally between corner and midline, and short, heavy marginal seta between these two setae; median transverse of 6 setae ( $MR_3$  nearly at lateral margin); 4 setae on each lateral margin. Venter of labrum densely set with spines that project anteriorly, anterior-most spines projecting well beyond anterior labral margin; each side with seta near lateral margin and another near midline at level of clypeolabral suture. Gula sharply tapered posteriorly, reducing minimum width to  $\frac{1}{2}$  maximum width; length of gula  $\frac{1}{2}$  greatest width of head; gular setae exceeding anterior margin of gula, length of setae about  $\frac{4}{5}$  gular width. Antenna about  $\frac{1}{4}$  as long as head; segment I  $2\times$  as wide as long; II sinuate, nearly  $3\times$  as long as I, nearly  $2\times$  as long as wide; III  $\frac{3}{5}$  as long as II,  $2\times$  as long as wide; sensory cone of II perfectly conical,  $\frac{7}{8}$  as wide as long, as long as, and nearly  $2\times$  as wide as, III; short, setiform organ in membrane beside cone; 3 apical setae on segments II and III (1 dorsal, 2 lateral), seta on posterior (outer lateral) margin of each segment longer than other two; terminal seta of III short,  $1\frac{1}{5}\times$  as long as II. Mandible robust; length (ventral condyle to apex)  $\frac{3}{5}$  head length,  $2\times$  basal mandibular width; 6 coarse, rounded teeth on mesal margin; proximal seta slightly longer than distal seta, as long as gular seta. Maxilla with cardo slender; stipes each with 3 long setae and 2 sensory pits ventrally near base, middle seta longer than others, longer than maxillary palpal segment III, mesal margin of stipes with several setae; mala with 2 long and 2 short, rather stubby setae. Maxillary palpus  $\frac{3}{5}$  as long as mandible; segments I and II equal in length,  $2\frac{1}{2}\times$  as wide as long, seta

on mesal margin of II as long as longest malar seta; III  $2\frac{1}{3}\times$  as long as II, nearly  $2\times$  as long as wide, widest at basal  $\frac{2}{5}$ , lateral margin evenly curved; sensory area of III extending about  $\frac{3}{5}$  length of segment, not overlapping onto ventral surface, papillae rodlike, separated by average distance equal to their length, not obscuring one another in dorsal view, 2-segmented sensory appendix  $\frac{2}{3}$  as long as II. Labium with prementum II transverse, emarginate anteriorly, with pair of short setae and sensory pits; prementum I deeply emarginate anteriorly, with pair of short and pair of long setae; pair of long setae on anterior labral margin between palpi; dorsal surface of prementum I densely spinous, with anteriormost spines visible along anterior margin in ventral view (not shown in Fig. 1). Labial palpus  $\frac{1}{2}$  as long as maxillary palpus, slender, cylindrical; segment I  $2\frac{1}{4}\times$  as wide as long, with short ventral seta; II weakly tapered,  $4\frac{3}{4}\times$  as long as I,  $2\frac{1}{10}\times$  as long as wide, mesal margin nearly straight, lateral margin slightly curved, with 1 dorsal seta, inserted at basal  $\frac{1}{3}$ , attaining sclerotized distal margin, 2-segmented sensory appendix slightly narrower than that of maxillary palpus.

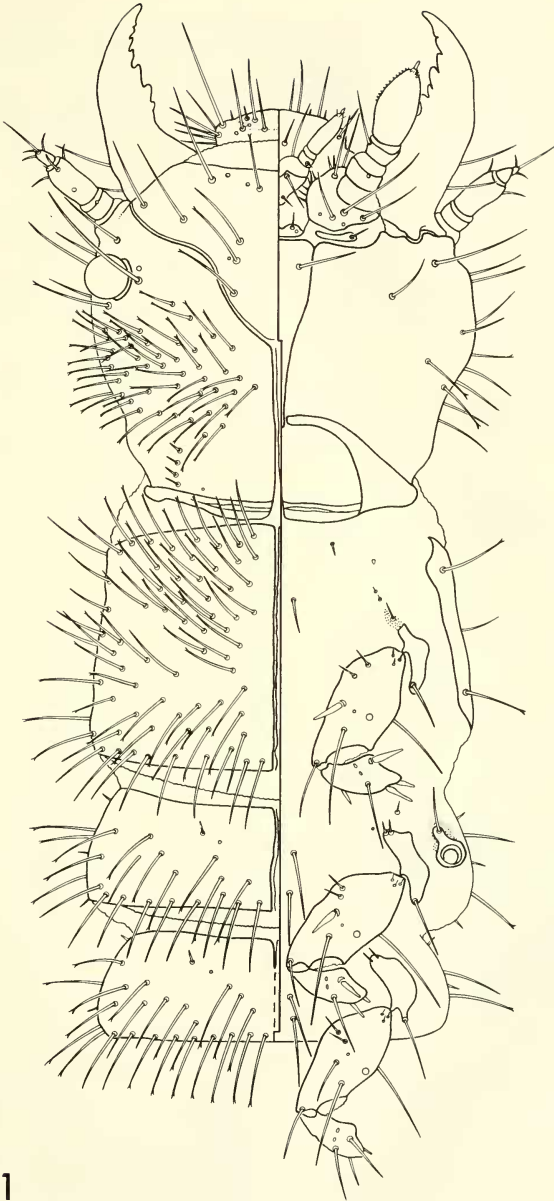
Thorax with line of dehiscence complete on pro- and mesonotum, weak, incomplete on metanotum. Pronotum widest at base, about  $1\frac{1}{2}\times$  as wide as long, as wide as head and  $\frac{7}{10}$  as long; sides nearly straight; about 134 setae, not arranged in recognizable rows. Mesonotum a little more than  $\frac{2}{3}$  as long as pronotum, nearly as wide; sides rounded, convergent anteriorly; about 42 long setae. Metanotum similar to mesonotum; about 46 long setae. Thoracic venter not sclerotized; each sternum with 4 setae in two rows; setae in AR of prosternum very short, widely separated from each other; setae of meso- and metasternum much longer than longest setae on prosternum.

Abdomen moderately tapered; tergite V slightly shorter than metanotum,  $\frac{1}{3}$  as long as wide. All long setae on tergites I–VIII divided at apex. Long setae on tergites I–

VIII arranged in median and posterior (marginal) rows (MR actually well posteriad of middle); MR setae shorter than PR setae; MR with 16 or 18 setae; PR with 32 setae on I–V, 28 on VI and VII, 20 on VIII. Spine-like evaginations at bases of PR setae strongly developed on tergites I–IV, weak on V, absent on VI–IX; no evaginations at bases of MR setae; tergite V with PR setae  $\frac{1}{3}$  as long as tergite. One pair of caudal setae on segment IX, a little shorter than segments VII–IX combined. Seta just laterad of caudal seta thicker than other tergal setae,  $\frac{1}{3}$  as long as caudal seta. Setae on pleurites and abdominal venter not divided at apex, generally longer than tergal setae. Pleurites large, distinctly separated from tergites, wider than long; pleurite I with 2 setae, II–VIII each usually with 3 (sometimes with only 2) long setae. Sternites of segments I–VII reduced to pair of small, narrow sclerites; sternites VIII and X well developed, undivided; sternum I with 2 setae of equal length on each sternite; II–IX each with PR of 6 setae, PR<sub>1</sub> longer than rest on II–VII, inserted at posterior end of sternite; II–VIII with MR of 2 setae, these shorter than PR<sub>1</sub>, inserted at anterior end of sternite on II–VII.

Spiracles round. Mesothoracic spiracle ventral; diameter  $\frac{2}{3}$  that of stemma; sclerous ring produced anteriorly to support an erect seta. Abdominal spiracles set in lateral  $\frac{1}{3}$  of pleurite, equidistant from anterior and posterior margins; spiracle I  $\frac{7}{10}$  diameter of mesothoracic spiracle; II–VIII progressively slightly smaller; VIII about  $\frac{1}{3}$  diameter of I.

Legs with coxae  $2\times$  as long as wide. Femora I–III progressively slightly longer, tibiae I–III markedly so. All lanceolate setae heavy. Coxae each with 4 long setae, one of which is lanceolate on I and II. Trochantins each with 4 setae, 3 of which are lanceolate on I and II. Femur I with 6 anterior and 5 posterior lanceolate setae; II and III each with 5 anterior and 4 posterior lanceolate setae; femur III  $\frac{1}{4}$  as deep as long. Tibiae with



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Fig. 1. Triungulin larva of *Psalydolytta fusca*, dorsal (left) and ventral (right) views of head and thorax.

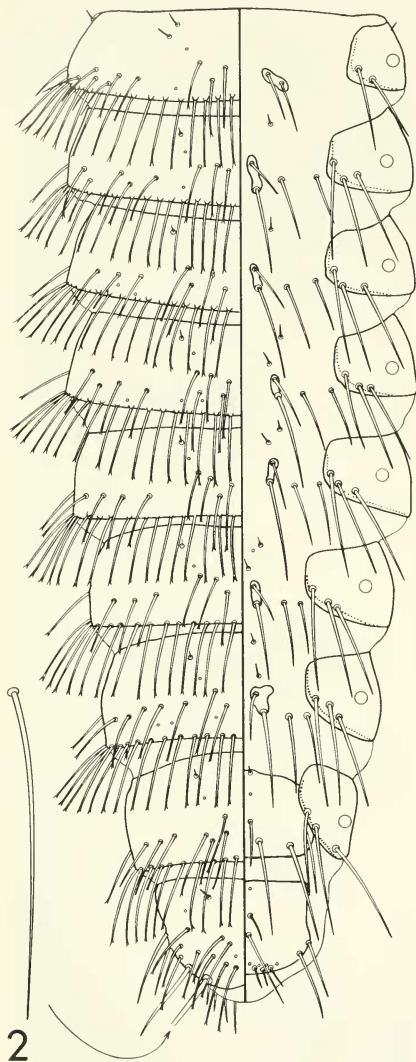


Fig. 2. Triungulin larva of *Psalydolytta fusca*, dorsal (left) and ventral (right) views of abdomen.

heavy curved seta dorsally at apex; tibia III with 11 setae in anteroventral rows. Tarsungulus III nearly  $\frac{2}{3}$  as long as tibia; anterior seta  $\frac{1}{2}$  as long as tarsungulus; posterior seta  $\frac{1}{3}$  as long as anterior seta.

Body length 5.2 (5.1–5.3) mm; caudal seta length 1.0 mm.

Material studied.—12 larvae, from eggs laid by a female taken at light at the Yundum airport, Western Division, The Gambia, 17 September 1985, by A. A. Laurence; eggs 18 September 1985, larva ca. 7 October 1985.

Remarks.—On the basis of the anatomy of the triungulin larva *P. fusca* the genus *Psalydolytta* clearly belongs in the Epicautina. The larva agrees with MacSwain's (1956) diagnoses of the Epicautina and *Epicauta* except for the large number of setae on the dorsal surface of the head and body and runs to *Epicauta* in his key to genera of Meloidae. [MacSwain's specification that the long ventral ("tactile") seta of the femur is inserted near the middle of that leg segment in the Epicautina is erroneous.] Within the Epicautina distinctive features of the larva of *P. fusca* are its (1) large body size, (2) the size and shape of its stemmata, and (3) numerous details of chaetotaxy resulting from a proliferation of setae.

As far as we can determine, the triungulin of *P. fusca* is the largest yet described in the Meloidae. The only larvae of comparable size are those of the South American species *Epicauta leopardina* (Haag-Rutenberg) (4.9 mm long) (Agafitei and Selander, 1980), the North American species *Megetra cancellata* (Brandt and Erichson) (4.0–4.5 mm) (Selander, 1965), and the Asian species *Mylabris quadripunctata* (Linnaeus) (4.0–4.5 mm) (Priamikova and Iukhnevitch, 1958). Otherwise, meloid triungulins do not exceed 4 mm in length, and most are considerably smaller. The larval stemmata are larger and more prominent in *P. fusca* than in other epicautines and are, among Meloidae, unusual in being perfectly spherical in shape.

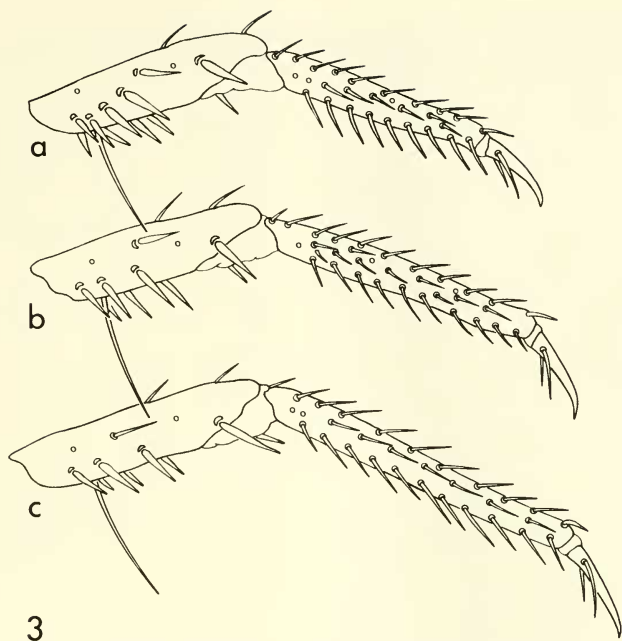


Fig. 3. Triungulin larva of *Psalydolytta fusca*. fore- (a), mid- (b), and hindleg (c). anterior views.

The most obvious diagnostic feature of the triungulin of *P. fusca* is the large number of setae on the head, body, and (to a lesser extent) legs. MacSwain (1956) specified a maximum of 60 pronotal setae in the Epicautina, but *P. fusca* has nearly twice that number. In most Meloidae the triungulin has six setae in MR and 10 in PR on abdominal tergites I–VIII. The number in PR is increased to 12 or 14 in several New World Epicautina (Agafitei and Selander, 1980; Selander and Agafitei, 1982) and reaches a maximum of 16 in *E. funesta* (Chevrolat) (Selander and Agafitei, 1982) and *E. dubia* (Fabricius) (Zakhvatkin, 1954) (attained also in the mylabrine genus *Coryna* Billberg, according to MacSwain, 1956). In contrast, *Psalydolytta fusca* has 16–20 setae in MR and 28–32 in PR. The tergal MR setae in *P. fusca* are also unusual for Epicautina in being

more than  $\frac{1}{2}$  as long as the PR setae. Ventrally the pattern of setation is more nearly normal in *P. fusca*, although here again there are more setae than usual (six rather than four in PR of abdominal sterna II–VIII and three rather than two on the pleurites). The number of lanceolate setae on the femora (11) is greater than usual for Epicautina but is matched in four species of the North American Vittata Group of *Epicauta*, where it varies intraspecifically from nine to 11 (Agafitei and Selander, 1980). One might expect a positive correlation between number of setae and body size in meloid triungulins, but except in the case of the lanceolate femoral setae there is no indication of such a relationship in the available data.

Apical division or branching of setae on the head, thorax, and abdomen of the triungulin larva has been recorded heretofore only

in the genus *Epicauta*, where it takes a variety of forms (Fig. 4). In the Old World the setae are simply bifid in the Palearctic species *E. ruficeps* (Illiger), *E. dubia*, *E. erythrocephala* (Pallas), and *E. rufidorsum* (Goeze) [= *E. verticalis* (Illiger)] and the Ethiopian species *E. albiovittata* (Gestro) (Cros, 1938; Zakhvatkin, 1929, 1954) and undivided in Palearctic species *E. gorhami* Marseul (Chu and Wang, 1956; Nagatomi and Iwata, 1958) and *E. megalcephala* (Gebler) (Zakhvatkin, 1954). Since the four species having bifid setae represent three of the 16 species groups of Old World *Epicauta* recognized by Kaszab (1952, 1953), we may presume that the characteristic is of widespread occurrence among Old World *Epicauta*. In the New World, where triangulin larvae of many species have been described, branched setae are known in only three species. In the Vittata Group, as studied by Agafitei and Selander (1980), *E. monachica* (Berg) has bifid setae similar to those of *P. fusca*.<sup>1</sup> In the same group the setae of *E. temexa* (Adams and Selander) are basically bifid, but there is a strong tendency for one or both of the branches of the seta to be further subdivided and the incidence of purely trifid setae is much higher than in *P. fusca*. Finally, in *E. niveolineata* (Haag-Rutenberg), representing the subgenus *Macrobasis* LeConte, there are, typically, multiple branches, some of which arise from the sides of the seta, well before the apex (Selander and Agafitei, 1982). The functional significance of setal branching is unknown, although one might suppose that adaptation to burrowing in a particular type of substrate, such as sand, is involved.

In view of the limited nature of the descriptive material available for larvae of the

Old World species of *Epicauta*, it is not possible to determine which Old World species group is phenetically closest to *P. fusca* or, for that matter, whether the *Psalydolytta* is phenetically closer to one or more of the New World groups of the genus than to the Old World groups. Kaszab (1952) described his Group I of *Epicauta*, which includes *E. cognata* (Haag-Rutenberg) and relatives in the Oriental Region and *E. canescens* (Klug) and relatives in the Ethiopian Region, as forming a link between *Epicauta* and *Psalydolytta* on the basis of similarities in the conformation of the adult mandibles. Unfortunately, the triangulin larva of this group is unknown. Among the New World groups, the Vittata Group is perhaps the most similar to *Psalydolytta*. However, judging from Cros' (1938) description of the triangulin larva of the Ethiopian *E. albiovittata*, there is at least an equally strong phenetic relationship between *Psalydolytta* and that species.

#### THE MODE OF LARVAL LIFE

Adults of *Psalydolytta fusca* attacking pearl millet spend their adult lives in the millet fields, feeding at night and hiding in the bases of the plants during the day. Captive females have been observed laying eggs in cavities in the soil, and it is probable that soil in and near millet fields is commonly used for oviposition. Although we were not aware in 1985 of Fletcher's (1914) association of *P. rouxi* with the eggs *Colemania sphenarioides*, the systematic position of *Psalydolytta* suggested that the larva of *P. fusca* would prove to be a predator of grasshopper eggs. Further, knowledge of the adult behavior suggested that larvae would be most readily found near infested millet fields. After several unsuccessful attempts to find grasshopper eggs by scraping off the top layer of soil in square-meter quadrats at several localities, one of us (AAL) finally discovered a substantial number of egg pods of acridid *Cataloipus fuscoeruleipes* (Sjöstedt) in soil at Tumani Tenda, Western Division, in an

<sup>1</sup> MacSwain (1956), Agafitei and Selander (1980), and Selander and Agafitei (1982) erred in attributing branched setae in Old World species of *Epicauta* only to *E. albiovittata*. Agafitei and Selander (1980) also erred in characterizing the setae of *E. monachica* as divided several times apically, rather than as bifid.



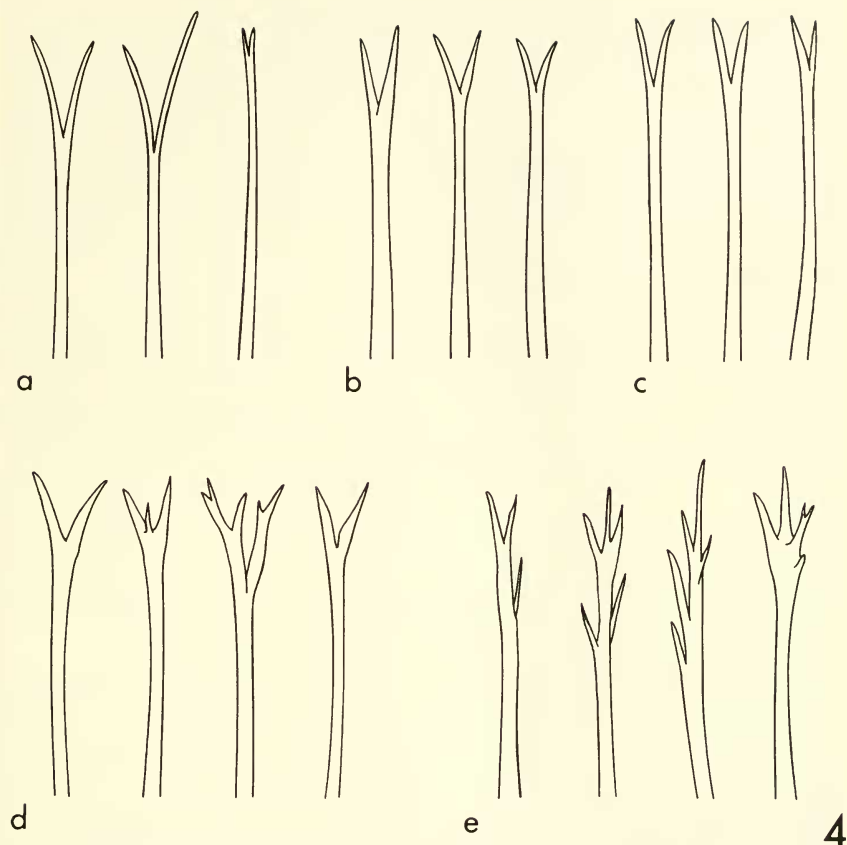


Fig. 4. Apically branched PR setae of abdominal tergite III of the triungulin larvae of *Epicauta albovittata* (after Cros, 1938) (a), *Psalydolytta fusca* (b), *E. monachica* (c), *E. temexa* (d), and *E. niveolineata* (e).

area of weeds and shrubs between swamp-rice fields and a pearl millet field that was heavily infested with adult *Psalydolytta fusca*.<sup>2</sup> Meloid larvae were found in three *Cataloipus* egg pods on 25 October 1985 and in four pods on 7 November 1985. All of

the pods containing larvae showed evidence of having been punctured. All were subsequently kept in darkness at 100% R.H. and 29–30°C in an attempt to rear the meloid larvae. An inventory of the contents of the pods follows, using the nomenclature of larval phases of Selander and Mathieu (1964). Except as noted, all larvae died in the instar in which they were found.

*Pod 1:* One triungulin ( $T_1$ ) larva, which escaped.

<sup>2</sup> In the classification of Dirsh (1965) *Cataloipus* Bolívar is placed in the Eyprepocnemidinae, a subfamily of Acrididae with which larval Meloidae have not been associated previously.

*Pod 2:* A last-instar first grub larva (FG<sub>5</sub>?) that ecdysed to the coarctate (C) phase two weeks after collection.

*Pod 3:* An FG larva of undetermined instar.

*Pod 4:* A T<sub>1</sub> larva positively identified as *Psalydolytta fusca* by comparison with reared triungulins and an FG<sub>2</sub> larva that reached FG<sub>3</sub> in captivity. The left side of the head of the T<sub>1</sub> possessed a large black scar, possibly the result of combat with the other larva.

*Pod 5:* An FG<sub>3</sub> larva and two FG larvae of undetermined instar. The left midleg of the FG<sub>3</sub> larva was missing except for the coxa, but there was no indication of injury to the cuticle.

*Pod 6:* A last-instar FG larva (FG<sub>5</sub>?) that ecdysed to the C phase two weeks after collection.

*Pod 7:* An FG<sub>5</sub> larva, not fully fed, and the exuvia of FG<sub>4</sub> (of which only the head capsule was preserved). This larva may have been injured during handling; when examined after death it had a large bubble on the left side of the thorax, as though hemolymph had extruded and coagulated.

Comparison of the FG larvae and exuvia with respect to size, setation, and numerous characters of the antennae, mouthparts, and legs leads us to believe that all of the grubs represent a single species. The instar of the exuvia identified as FG<sub>4</sub> can be specified confidently on the basis of its resemblance to a T larva in several characters, particularly those of the legs. The larva that produced this exuvia is, then, an FG<sub>5</sub>, and since the exuvial head capsule associated with the larva in pod 7 is larger than that of the FG<sub>3</sub>, it must represent FG<sub>4</sub> and its associated larva FG<sub>5</sub>. Very likely the two larvae that reached the C phase were, when found, in instar FG<sub>5</sub> also, since this is commonly the last instar of the FG phase in Meloidae. The assignment of instar numbers, as well as our contention that the larvae are conspecific, is supported by the fact that a plot of the logarithm of the width of the frontal sclerite of the head against known or inferred instar

number is quite linear ( $n = 6$ ,  $r = .990$ ,  $P = .00015$ ). The estimated regression equation for the relationships is  $\hat{y} = -.2640 + .1274x$ .

As for the identification of the FG larvae, the exuvia of the FG<sub>2</sub> larva is so large as virtually to rule out its representing any species but *P. fusca*. In particular, the size of the FG<sub>2</sub> would seem definitely to exclude the possibility of its representing *Mylabris holosericea* (Klug), a relatively small meloid, as an adult, often occurring in millet fields with *P. fusca*, although generally less abundantly. Additional evidence bearing on the identity of the larvae associated with *Cataloipus* is the fact that the spiracles of the C larvae obtained by rearing occupy mound-like protuberances of the cuticle that appear to sag posteriorly, tipping the spiracular cones in that direction. Until now this feature has been regarded as diagnostic of the genus *Epicauta*, but its occurrence in *Psalydolytta* would not be surprising, given the close relationship of the two genera. At the very least it would seem to establish that the larvae are epicautine.

In summary, while it is clear that T<sub>1</sub> larvae of *Psalydolytta fusca* are capable of entering the egg pods of *Cataloipus*, our data provide only circumstantial evidence that *P. fusca* larvae eat the eggs of this grasshopper, since the T<sub>1</sub> larvae found in the field had not fed to an appreciable extent and the FG larvae cannot be identified with certainty as *P. fusca* at this time. Nevertheless, we are reasonably confident that *P. fusca* is, in fact, a larval predator of *Cataloipus*.<sup>3</sup>

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<sup>3</sup> After submission of this paper for publication, one of us (AAL), by releasing groups of T<sub>1</sub> larvae on moist sand containing egg pods of *Cataloipus fuscocoeruleipes*, successfully reared two larvae of *P. fusca* to the C larval phase. The C larvae from this rearing are similar to those obtained earlier from FG larvae collected in the field.

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## LITERATURE CITED

- Adams, C. L. and R. B. Selander. 1979. The biology of blister beetles of the Vittata Group of the genus *Epicauta* (Coleoptera, Meloidae). Bull. Am. Mus. Nat. Hist. 162(4): 137-266.
- Agafitei, N. J. and R. B. Selander. 1980. First instar larvae of the Vittata Group of the genus *Epicauta* (Coleoptera: Meloidae). J. Kans. Entomol. Soc. 53: 1-26.
- Chu, H.-F. and L.-Y. Wang. 1956. On the life-history of the legume blister beetle, *Epicauta gorhamii* Marseul, with a discussion of hypermetamorphosis. [In Chinese, with English summary.] Acta Entomol. Sinica 6: 61-73.
- Cros, A. 1938. Considerations générales sur le genre *Epicauta* Redtenbacher. Etude biologique sur *Epicauta albovittata* Gestro. Mem. Soc. Entomol. Ital. 16: 129-144, pl. 3.
- Dirsh, V. M. 1965. The African genera of Acridoidea. Cambridge University Press, Lond, xii + 579 pp.
- Fletcher, T. B. 1914. Some South Indian insects. Superintendent, Government Press (Madras, India), vii + 565 pp.
- Giglioli, M. E. C. 1965. Some observations on blister beetles, family Meloidae, in Gambia, West Africa. Trans. R. Soc. Trop. Med. Hyg. 59: 657-663.
- Kaszab, Z. 1952. Die paläarktischen und orientalischen Arten der Meloiden-Gattung *Epicauta* Redtb. Acta Biol. Acad. Sci. Hung. 3: 573-599.
- . 1953. Revision der äthiopischen Arten der Meloiden-Gattung *Epicauta* Redtb. Acta Biol. Acad. Sci. Hung. 4: 481-513.
- . 1954. Die Arten der Meloiden Gattung *Psalydolytta* Per. (Coleoptera, Meloidae). Acta Zool. Acad. Sci. Hung. 1: 69-103.
- . 1959. Phylogenetische Beziehungen des flügelgedäders der Meloiden (Coleoptera), nebst Beschreibung neuer Gattungen und Arten. Acta Zool. Acad. Sci. Hung. 5: 67-114.
- . 1969. The system of the Meloidae (Coleoptera). Mem. Soc. Entomol. Ital. 48: 241-248.
- MacSwain, J. W. 1956. A classification of the first instar larvae of the Meloidae (Coleoptera). Univ. Calif. Publ. Entomol. 12, iv + 182 pp.
- Nagatomi, A. and K. Iwata. 1958. Biology of a Japanese blister beetle, *Epicauta gorhamii* Marseul (Coleoptera, Meloidae). Mushi 31: 29-46, pl. 4.
- Priamikova, M. A. and L. A. Iukhnevich. 1958. Key to the triungulins of blister-beetles (Coleoptera, Meloidae) of the tribe Mylabrini in the fauna of the USSR. [In Russian.] Entomol. Obozr. 37: 176-182. [English translation in Entomol. Rev. 37: 139-145.]
- Saha, G. N. 1979. Revision of Indian blister beetles (Coleoptera: Meloidae: Meloinae). Records Zool. Surv. India 74(1): 1-146.
- Selander, R. B. 1955. The blister beetle genus *Linsleya* (Coleoptera, Meloidae). Am. Mus. Novit. 1730, 30 pp.
- . 1965. A taxonomic revision of the genus *Meggetra* (Coleoptera: Meloidae) with ecological and behavioral notes. Can. Entomol. 97: 561-580.
- . 1981. Evidence for a third type of larval prey in blister beetles (Coleoptera: Meloidae). J. Kans. Entomol. Soc. 54: 757-793.
- . 1986. An annotated catalog and summary of bionomics of blister beetles of the genus *Psalydolytta* (Coleoptera, Meloidae). Insecta Mundi. [In press.]
- Selander, R. B. and N. J. Agafitei. 1982. First-instar larvae of the Uniforma Group of the genus *Epicauta* (Coleoptera, Meloidae). Proc. Entomol. Soc. Wash. 84: 138-148.
- Selander, R. B. and J. M. Mathieu. 1964. The ontogeny of blister beetles (Coleoptera, Meloidae) I. A study of three species of the genus *Pyrota*. Ann. Entomol. Soc. Am. 57: 711-732.
- Zakhvatkin, A. A. 1929. The biology and morphology of the parasites of the egg-pods of Acrididae in Central Asia. 1. Description of the triungulin of *Epicauta erythrocephala* Pall. (Col., Meloidae). [In Russian.] Sredneziatsk. Inst. Zashch. Rast. (Tashkent) 15 (1928), 7 pp.
- . 1954. Parasites of Acrididae of the Angara Region. [In Russian.] Trudy Vsesoyuz. Entomol. Obsch. 44: 240-300.
- Zethner, O. and A. A. Laurence. 1987. Investigations on the economic importance and control of the adult blister beetle *Psalydolytta fusca* (Olivier) (Coleoptera: Meloidae), a serious pest of pearl millet in The Gambia. Trop. Pest Manag. [In press.]
- Zethner, O., S. B. Sagnia, A. A. Laurence, and S. Bruce-Oliver. 1985. CILSS Integrated Pest Management Project Annual Report 1985. Entomology. Yundum, The Gambia, 110 pp.